

Project Title

Identification of factors associated with Nursing Home and Community Hospital Referrals using Association Rule Mining

Project Lead and Members

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Organisation(s) Involved

Tan Tock Seng Hospital

Healthcare Family Group(s) Involved in this Project

Medical, Ancillary Care, Nursing, Healthcare Administration

Applicable Specialty or Discipline

Medical Social Workers, Psychology, Psychiatry, Infectious Diseases, Orthopaedics

Project Period

Start date: Not Applicable

Completed date: Not Applicable

Aims

To identify the underlying factors associated with NH and CH referrals using Association Rule Mining, with the goal of facilitating the prompt identification of patients who require such referrals.

Background

See poster attached/below

Methods

See poster attached/below

Results

See poster attached/below

Lessons Learnt

See poster attached/below

Conclusion

See poster attached/below

Additional Information

Accorded the Singapore Health & Biomedical Congress 2023 (Singapore Young Investigator Award (Health Services Research) Silver Award

Project Category

Applied/ Translational Research

Quantitative Research

Care Continuum

Intermediate and Long Term Care & Community Care, Nursing Home Care

Intermediate and Long Term Care & Community Care, Right-Siting

Keywords

Length of Stay, Resource preparation, Community Care, Waiting Time

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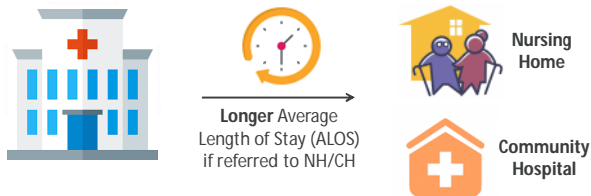
Identification of factors associated with Nursing Home and Community Hospital Referrals using Association Rule Mining

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Background

In Tan Tock Seng Hospital (TTSH), inpatients referred to Nursing Homes (NH) and Community Hospitals (CH) typically experience longer stays on average compared to those who were not referred.

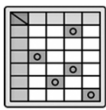


Objective

To identify the underlying factors associated with NH and CH referrals using Association Rule Mining, with the goal of facilitating the prompt identification of patients who require such referrals.

Methodology

1 Prepare Data



**Inpatient Discharges between
1 Jan 2016 to 29 Jul 2022
(n=398,219)**

Excluded: Buffer Stepdown Unit (BSU), Short Stay Unit (SSU) cases

Features (One-Hot Encoded)

- Demographics (e.g., age group, stay in rental flat)
- Medical (e.g., specialty touchpoints, principal diagnosis, Charlson Comorbidity Index, stayed in ICU/HD, MRSA/VRE/CPE)
- Psychosocial (e.g., history of caregiver stress, strained relationships, social isolation, presence of behavioural, psychiatric issues or confusion)
- Referral to NH/CH

[Year-by-year Analysis]

2 Generate Frequent Item-sets using Apriori Algorithm

Key Ideas

1. All subsets of a frequent itemset* must be frequent.
2. If an itemset* is infrequent, all its supersets will be infrequent.

* An itemset (in this study) refers to the set of binary variables that have a value of 1 for each inpatient case.

3 Generate Candidate Association Rules

- From the frequent itemsets, generate association rules, i.e.: (Antecedent(s) → Consequent)
- Narrowed down to rules having either "Referral to NH" or "Referral to CH" as the consequent.

4 Prune Rules based on Statistical Significance

Key Idea

1. An association rule ($X \rightarrow Y$) is statistically significant, if it has a small probability to occur by chance.

5 Prune Redundant Rules

Key Idea

1. Rule ($X \rightarrow Y$) is redundant if there exists a more general rule ($Z \rightarrow Y$) that is more significant.

Results

Figure 1. Probability of Referral to NH (Yearly Top 5 Associated Factors)

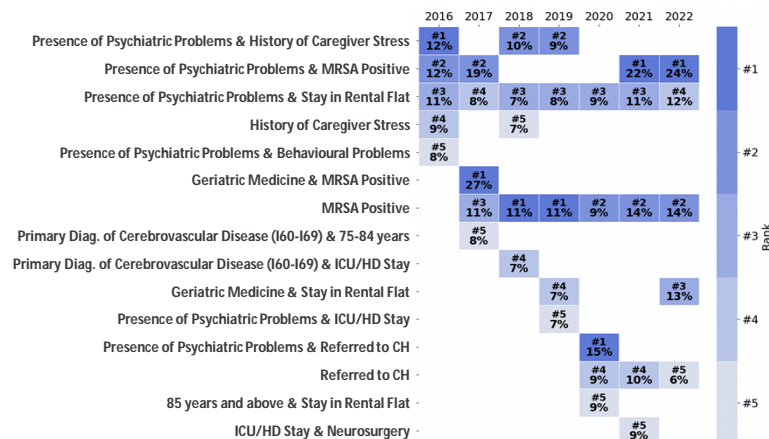
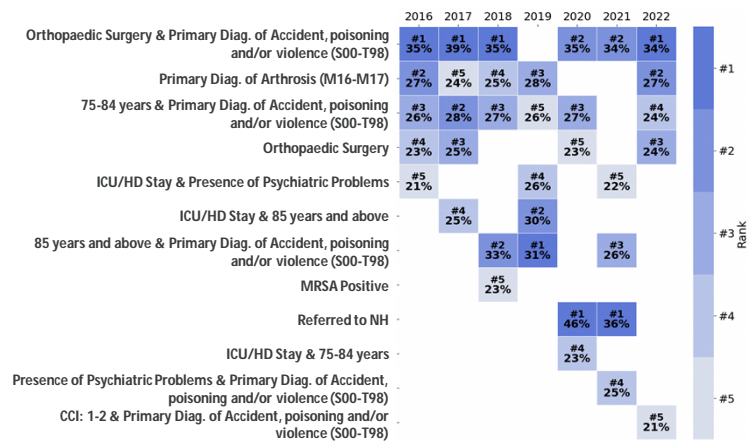


Figure 2. Probability of Referral to CH (Yearly Top 5 Associated Factors)



Discussion

Notable Factors associated with Referrals to NH

- Having psychiatric problems and staying in rental flats.
- MRSA-Positive (since 2017).
- MRSA-Positive and having psychiatric problems (2021-2022).

Notable Factors associated with Referrals to CH

- Primary diagnosis of accident, poisoning or violence (S00-T98) and having touchpoint(s) with Orthopaedic Surgery.
- Primary diagnosis of Arthritis (M16-M17) (except for 2020-2021).
- Patients referred to NH in 2020-2021 (due to decanting of NH cases).

Conclusion

Association rule mining enabled the discovery of patterns from data using unsupervised learning. The rules would facilitate decision-making and resource preparation for NH/CH referrals, and possibly reducing unnecessary days of stay in the hospital due to waiting time.

References

Hämäläinen, W., Webb, G.I. A tutorial on statistically sound pattern discovery. Data Min Knowl Disc 33, 325–377 (2019).
<https://doi.org/10.1007/s10618-018-0590-x>